



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

AF/ 2800
#27/Heenan
9-400

In re Application of:

HEENAN, Sidney A., et al.

Serial No.: 09/453,327

Filed: December 2, 1999

For: RETROREFLECTIVE ARTICLES
HAVING MICROCUBES, AND TOOLS AND
METHODS FOR FORMING MICROCUBES

Examiner: J. Phan

Art Unit: 2872

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RESPONSE

Mail Stop AF
Commissioner for Patents
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Dear Sir:

This is in response to the Office Action mailed June 18, 2003 in regard to the above-identified application, and in furtherance of the in-person interview conducted July 31, 2003, the courtesy of which is acknowledged with appreciation.

In the June 18 Office Action, the Examiner stated that the arguments put forth in the Amendment mailed April 2, 2003 were considered but deemed moot in view of the new ground of rejection. Specifically, the examiner finally rejected pending claims 1-11, 18, 26, 29-30, and 91-94 as obvious under 35 U.S.C. 103(a) over Heenan '090 in view of the document DE 4236799 (Gubela) and Szczech U.S. 5,138,488. The Examiner stated:

Heenan '090 in view of the document DE 4236799 discloses all claimed features discussed on pages 3-4 of paper no. 23 [office action of January 2, 2003] except for at least one microcube being canted edge-more-parallel. Szczech '488 discloses a cube-corner

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retroreflective article having at least one microcube being canted edge more parallel for improving the angularity of the retroreflective article (see Fig. 4A and the accompanying text). Thus, it would have been obvious to one skilled in the art at the time the invention was made to apply the teaching of Szczech '488 to Heenan '090 in view of the document DE 4236799 for improving the angularity of the reflected article.

The final rejection is respectfully traversed.

The independent claims in this application are claims 1, 26 and 94. Claim 1 encompasses an article comprising an array of non-rulable microcubes, at least one of which is non-hexagonal and has a projected area of less than 1 mm^2 , and that is canted edge-more-parallel. Claim 26 encompasses an array of non-rulable rectangular microcubes, at least one of which has a projected area of less than 1 mm^2 , and that is canted either edge-more-parallel or face-more parallel. Claim 94 encompasses an article comprising an array of microcubes, where every region of three by three microcubes contains at least one rectangular microcube that has a projected area of less than 1 mm^2 , and that is canted edge-more-parallel.

The Heenan '090 and Gubela '799 references were discussed in the remarks to the Amendment mailed April 2, 2003. Neither Heenan '090 nor Gubela '799 contains an enabling disclosure for the manufacture of canted, non-rulable, non-hexagonal microcubes having a projected area of less than 1 mm^2 .

The Szczech '488 reference discloses the manufacture of an array of canted triangular cube corners by ruling. This is very old technology in the art of cube corner retroreflective articles made from triangular cube corners. It was well-known in the prior art that triangular cube corners could be canted either edge-more-parallel or face-more-parallel, at the option of the tooling designer. See, for example, the discussion in Jungersen U.S. 2,310,790, at page 3, left column, lines 57-74, and Fig. 15; Hoopman, U.S. 4,588,288; and Stamm U.S. 3,712,706. Each

of these references is of record in this case and the parent case. See also the disclosure of the instant application at col. 2, line 66 – col. 3, line 12, and references cited therein (for the sake of convenience, references herein to the instant application are made with respect to the column and line numbers of the corresponding issued parent case U.S. 6,015,214). Also submitted herewith is the Declaration Dennis I. Couzin, in which the terms “face-more-parallel” and “edge-more-parallel” are explained in the context of triangular cubes in paragraphs 5-9.

Ruled canted triangular microcubes of the prior art, whether canted face-more-parallel or edge-more-parallel, are very different from the canted non-rulable, non-hexagonal microcubes disclosed and recited in the pending claims of the instant application. First, as explained in the application at col. 3, line 51- col. 4, line 13, triangular cubes suffer the known disadvantage that inherently by their geometry no more than 66% of their area can be retroreflective for any particular incidence angle, while rectangular cube corners (as well as hexagonal cube corners) have the advantage that 100% of their area can be retroreflective even at large incident angles. Second, as explained in the application at col. 23, line 60 – col. 24, line 4, rectangular microcubes offer far greater design freedom than either hexagonal or triangular microcubes. This is because for rectangular microcubes, the design parameters of cube axis cant, apex centration, and rectangular proportions (length to width) are each independently variable, as illustrated in Fig. 28. By comparison, for hexagons, a change in one of the parameters requires a change in one of the other two, and for ruled triangles, all three parameters are inextricably interrelated, such that setting one of the parameters inherently determines the other two. See the Declaration of Dennis I. Couzin, paragraphs 5-9.

Yet despite the known advantages of rectangular cube corners, it was never possible, prior to the instant invention, to achieve rectangular cube corners of micro size, because it was

not possible to cut and polish inside-intersecting faces (such as are present in rectangular cube corner arrays) with the precise angular tolerances and sharp edges achievable with the prior art macrocube pin technique. See the instant application at col. 5, lines 7-24. The instant application is the first known enabling disclosure of canted, non-rulable, non-hexagonal micro-sized cube corner elements as recited in the instant claims.

The data in the application demonstrates the unexpected results achieved by the claimed microcube arrays compared to prior art arrays, including the canted triangles of the prior art Hoopman reference. See Figs. 43, 44 and 45, discussed at col. 24, line 58- col. 25, line 7. See also col. 25, line 27-col. 6, line 12. As explained therein, the cube corner arrays of the instant claims unexpectedly provide desirably flat curves of percent active aperture versus entrance angle over a range of -20° to $+20^{\circ}$, i.e., the retroreflectivity of these arrays is surprisingly uniform over this broad range of entrance angles. Furthermore, the active aperture curve of these arrays is superior to that of the arrays of the prior art Hoopman patent by 48% over this entrance angle range, and continue to be superior to Hoopman over a range of -50° to $+50^{\circ}$. These unexpected results are evidence of the non-obviousness of the invention over the prior art.

Nothing in Szczech '488, taken in combination with Heenan '090 and Gubela '799, teaches or suggests these unexpected and desirable results that can be achieved with arrays of the instant invention. Nor do the ruled canted triangular cubes of Szczech, taken either alone or in combination with Heenan '090 and Gubela '799, teach one skilled in the art about non-rulable, non-hexagonal canted microcubes, or how to make them.

At the interview, it became apparent that, possibly due to an error in one of the Figures in the Szczech '488 patent, the Examiner had been under the impression that Szczech '488 discloses edge-more-parallel microcubes. The Examiner requested a Declaration to show that

the cubes shown in Szczech '488 Figs. 4A-4B are not being canted edge-more-parallel. In the Declaration of Dennis I. Couzin, at paragraphs 10-15, it is explained that Szczech '488 Figs. 4A-4B illustrate face-more-parallel triangular cubes.

In view of the foregoing, a Notice of Allowance is respectfully requested.

Respectfully submitted,



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